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AIR-BLAST GIN PERFORMANCE AND MAINTENANCE

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INTRODUCTION

More than one-third of the ginneries in the United States were equipped with the air-blast type of gin during the 1935 season. These establishments possibly ginned about one-third of the cotton crop, or approximately 3½ million bales. The distribution of the bales so ginned reveals that about 1½ million were ginned in the western group of States where 53 percent of the saw-gin stands were of the air-blast type. In the central and southeastern groups of States, the proportions of gins of this type were 30 and 28 percent, respectively, and it is estimated that nearly a million bales of cotton were ginned on air-blast gins in each of these sections in 1935.[2]

The air-blast gin received its name from the employment of a jet or blast of air to remove ginned lint from the saw cylinder. Usually each saw jet uses a water-gage pressure of from 9 to 15 inches. The shape, condition, and position of the nozzle through which the air blast operates is of major importance, because the nozzle must provide a uniform stripping blast against the peripheral portions of the saws at a correct angle, generally tangential to their direction of rotation.

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[1] The cotton-quality phases of this circular are a part of the program of cotton utility and standards research under the leadership of R. W. Webb, principal cotton technologist, Bureau of Agricultural Economics. Credit is due to Francis L. Gerdes, cotton technologist, Bureau of Agricultural Economics, and Charles A. Bennett, senior mechanical engineer, Bureau of Agricultural Engineering, for supervision and suggestions, to coworkers for assistance in the ginning experiments and laboratory tests, to Hughes Butterworth, specialist in cotton classing, Bureau of Agricultural Economics, for making the cotton classifications, and to the Board of Supervising Cotton Examiners for reviewing the classifications.

[2] These figures are based on reports of the Bureau of the Census, Cotton Ginning Machinery and Equipment, 1935, by States, and on the assumption that air-blast gins handle about the same quantity of cotton per ginnery as brush gins. In this circular, the western group comprises the States of Arizona, California, New Mexico, Oklahoma, and Texas; the central group, Arkansas, Louisiana, Mississippi, Missouri, and Tennessee; and the southeastern group includes Alabama, Florida, Georgia, North Carolina, South Carolina, and Virginia.

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Obsolete or defective fans, faulty drives, restricted intakes, poorly arranged or leaky piping, or other adverse factors may thus individually or together become a source of inefficiency in operating air-blast gins.

The importance of adequate volume and constant pressure of air for properly removing the lint from saws was early recognized, as seen by records of patents issued on devices for maintaining a continuous blast of air at the air-blast nozzle. The original patent on the air-blast gin, granted in 1902 to Robert B. Lumpkin,[3] provided for a constant nozzle pressure by means of a head of water on an expansion chamber. The patent granted to Frank Phelps in 1911 [4] provided for a uniform distribution of the stripping blast across the saws by means of a special wind board. Later air-blast gins were so designed and constructed that if the piping was correct and the air-blast mechanism was properly set up and was checked periodically, the adequate nozzle pressure for doffing was provided economically.

Installations in which adjustments cannot readily be made to suit each of the different conditions encountered in the cotton have become unusual. The modern air-blast system lends itself readily to the adjustments that may be needed. It is the purpose of this circular, therefore, to point out the effects of insufficient or excessive nozzle pressures on the quality and value of the lint and on ginning capacity, power requirements, and energy consumption of the gin stand and to describe necessary instruments and procedure for checking and maintaining settings and pressures.

AIR-BLAST GIN PERFORMANCE AT DIFFERENT NOZZLE PRESSURES

To study the effect of air-blast pressure on doffing, a series of tests was conducted at the United States Cotton Ginning Laboratories at Stoneville, Miss., during the 1935 and 1936 ginning seasons. Double-rib huller-type air-blast gins, having 12-inch saws, were used, and were operated at a speed recommended by the manufacturer. These gins were of two representative types—the high-speed and low-speed, air-blast gins (fig. 1). The position of the nozzle was held constant at the factory setting throughout these tests. The operator made every effort to maintain a constant loose seed-roll density by observing elements of ginning, similar actions were obtained on both gins accordingly.[5] Analyses of the data indicate that from the standpoint of effect on the grade and staple length of the lint and on the operating elements of ginning, similar actions were obtained on both gins with respect to the effects of the variations made in air-blast pressures. The results obtained with each pressure were therefore averaged for the two types of gins.

The air-blast fan was driven by a variable speed unit so that the nozzle pressure, measured in inches of water in the gage, could be regulated for each condition by changing the fan speed.

In these studies 42 cottons from the 1935 and 1936 crops were used. Equal portions of each of 12 of these were ginned on a high-speed

[3] LUMPKIN, ROBERT B. Cotton Gin, U. S. Patent No. 700,347. May 20, 1902.
[4] PHELPS, FRANK. Cotton Gin, U. S. Patent No. 1,013,053. December 26, 1911.
[5] BENNETT, CHARLES A., and GERDES, FRANCIS L. EFFECTS OF GIN-SAW SPEED AND SEED-ROLL DENSITY ON QUALITY OF COTTON LINT AND OPERATION OF GIN STANDS. U. S. Dept. Agr. Tech. Bull. 503, 40 pp., illus. 1936.

and on a low-speed air-blast gin. Portions of 17 of the other cottons were ginned on the high-speed gin and portions of the remaining 13

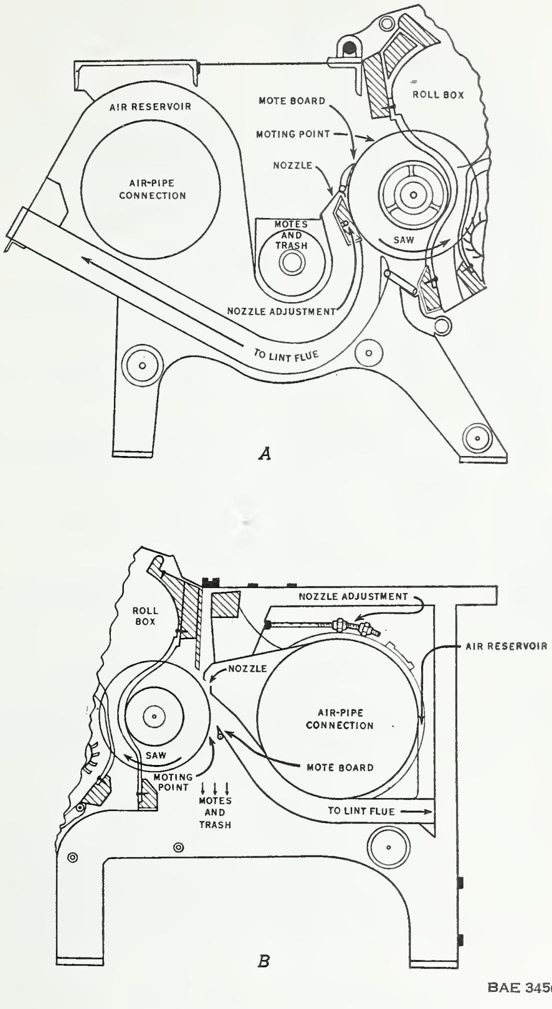

Figure 1.—Cross-sectional view of two representative types of air-blast gins: *A*, high-speed; *B*, low-speed.

were ginned on the low-speed gin. The cottons used were of the upland varieties grown in Arkansas, Georgia, Louisiana, Mississippi, Tennessee, and Texas (table 1).

TABLE 1.—*Seed cottons used in air-blast gin pressure tests, 1935 and 1936*

COTTON 1⅛ INCHES AND LONGER

Identification of cotton		Variety	Place of growth	Harvesting date	Moisture content of seed cotton [1]	Foreign-matter content of seed cotton [2]	Laboratory determinations [3]					Cotton classer's appraisals [6]	
Moisture-content group (percent)	Lot No.						Weight of 100 seeds	Weight of lint from 100 seeds	Proportion of lint	Upper-quartile fiber length [4]	Variability of fiber length [5]	Staple length	Grade
					Percent	*Percent*	*Grams*	*Grams*	*Percent*	*Inches*	*Percent*	*Inches*	
12 and above	[7] 601	Stoneville 2B	Stoneville, Miss	Aug. 11–12	15.2	0.8	13.15	6.74	33.9	1.24	56.6	1 5/32	S. M., B.
	[7] 602	Delfos 531	Dunleith, Miss	Aug. 12	12.1	.7	11.74	5.69	32.6	1.27	63.8	1⅛	S. M., B.
	[7] 603	Delfos 9252	Stoneville	do	12.7	.9	12.39	5.66	31.4	1.32	76.2	1¼	S. M., B.
	[7] 605	Stoneville 2A	Burdette, Miss	Aug. 13	12.1	.7	12.78	6.34	33.2	1.18	57.6	1 5/32	S. M., B.
	624	Missdel 7	Stoneville	Aug. 19	12.2	.6	13.94	6.08	30.4	1.31	53.1	1¼	M., B.
	644	Missdel 3-1411	do	Sept. 9	13.2	1.4	11.49	4.88	29.8	1.29	72.7	1 3/16	M., B.
	656	Missdel 3	Leland, Miss	Sept. 15	12.1	.7	12.34	5.41	30.5	1.28	65.6	1 5/32	S. M., B.
	698	Missdel 6	Stoneville	Oct. 15	14.1	1.6	11.56	4.58	28.4	1.16	90.4	1⅛	S. L. M., B.
Below 12	474	Missdel 4	do	Sept. 16	10.4	1.4	11.87	6.27	34.6	1.21	71.9	1⅛	S. M., B.
	475	Delfos 9252	Magenta, Miss	Sept. 19	7.0	1.4	13.12	5.90	31.0	1.26	64.6	1 5/32	S. L. M., B.
	476	do	Stoneville	Sept. 27	7.6	1.6	12.95	5.95	31.5	1.25	63.8	1⅛	L. M., B.
	479	Delpress 3	do	Aug. 27	11.6	1.5	12.70	5.50	30.2	1.27	84.3	1⅛	M., B.
	509	Stoneville 2A	Wilmot, Miss	Sept. 30	7.3	1.3	11.17	5.26	32.0	1.10	84.4	1⅛	S. L. M., B.
	540	Delpress 3	Stoneville	Sept. 11	9.4	1.9	12.42	5.35	30.1	1.26	90.9	1 5/32	S. L. M., B.
	554	Missdel 4	do	Sept. 20	8.9	1.6	11.64	6.10	34.4	1.20	85.3	1⅛	L. M., B.
	559	Missdel 6	do	Oct. 26	9.5	1.7	12.21	4.93	28.8	1.21	93.7	1 5/32	S. L. M., B
	[7] 608	D. P. L. 11	Greenville, Miss	Aug. 11–12	8.0	.4	11.36	6.17	35.2	1.20	77.1	1⅛	G. M., B.
	610	Missdel 3-1411	Stoneville	Aug. 19	8.9	1.6	12.68	5.76	31.2	1.33	71.4	1 3/16	M., B.
	620	Missdel 6	do	Aug. 20	8.4	1.4	12.14	4.67	27.8	1.21	85.2	1⅛	M.,B.
	623	do	do	Aug. 27	11.0	1.5	12.04	4.66	27.9	1.19	98.1	1⅛	M., B.
	627–A	Delfos 9252	Greenville	Aug. 20–21	7.6	1.3	12.79	5.28	29.2	1.38	77.9	1⅛	M., B.
	637	do	do	Sept. 2–3	6.7	1.0	13.26	5.03	27.5	1.38	79.6	1 3/16	S. M., B.
	639	Missdel 1-0539	Stoneville	Aug. 26	10.4	1.2	12.22	4.96	28.9	1.32	75.3	1⅛	M., B.
	670–A	Missdel 7	do	Sept. 18	9.1	1.2	12.05	5.25	30.3	1.23	65.1	1⅛	M., B.

COTTON SHORTER THAN 1⅛ INCHES

12 and above	[7] 607	Rhyne's Cook	Tifton, Ga	Aug. 3–12	13.6	2.7	10.40	6.46	38.3	.94	62.6	7/8	S. M. sp.
	[7] 615	Dixie Triumph	Baton Rouge, La	Aug. 19	12.4	1.1	10.69	5.61	34.4	1.09	65.4	31/32	M.
	638–A	do	do	do	12.0	2.4	10.69	5.61	34.4	1.09	65.4	29/32	S. L. M. sp.
	642	Rowden 40	Montrose, Ark	Sept. 8	15.6	2.0	14.09	7.06	33.4	1.08	57.5	31/32	S. M. sp.
	643	Wilson Big Boll	Wilson, Ark	do	16.1	3.9	10.84	4.47	29.2	1.07	62.9	31/32	S. M. sp.
	651	Dixie Triumph	Baton Rouge	Sept. 9	12.1	1.1	10.22	5.52	35.1	.97	83.1	15/16	S. L. M.
	[7] 655	D. P. L. 11	Ridgely, Tenn	Sept. 14–15	13.7	2.1	10.56	5.08	32.5	1.19	57.8	1 3/32	M.
Below 12	491	Dixie Triumph	Baton Rouge	Sept. 26	8.7	2.6	10.46	4.89	31.8	.98	83.6	31/32	S. L. M.
	536	Missdel 6	Stoneville	Sept. 17	8.7	1.4	11.30	4.58	28.8	1.17	85.1	1 3/32	L. M.
	537	Rowden 40	Montrose	Oct. 15	7.0	1.2	11.14	5.71	33.9	.98	76.6	31/32	M.
	558	Missdel 6	Stoneville	Oct. 8	7.2	2.8	11.50	4.66	28.8	1.13	84.6	1 3/32	S. L. M.
	[7] 606	Bennett	Edroy, Tex	Aug. 10	8.2	3.5	12.76	6.13	32.5	1.11	77.2	1	M.
	[7] 614	Lone Star	Greenville	Aug. 17–19	6.7	1.1	11.47	7.10	38.2	1.04	62.1	15/16	S. M.
	625	Rowden 40	Montrose	Aug. 27	9.0	.6	12.88	6.16	32.4	1.06	74.7	31/32	S. M.
	[7] 628	Half & Half	Edroy	Aug. 20	7.5	3.9	11.24	6.75	37.5	.93	66.9	15/16	S. L. M.
	[7] 636	Stoneville 2B	Stoneville	Sept. 1–3	6.6	1.1	11.83	5.54	31.9	1.21	66.6	1 3/32	S. M.
	641	Rowden 40	Montrose	Sept. 7	8.5	1.0	12.69	6.08	32.4	.95	75.6	31/32	S. M.
	661	Stoneville 2A	Leland	Sept. 7–11	9.6	.5	12.24	5.52	31.1	1.15	65.0	1 1/16	S. M.

[1] As determined by oven tests.
[2] As determined by fractionation tests.
[3] Lint hand-pulled from seed.
[4] Length of the fibers at the 25-percent point on the length-cumulative weight percentage curve beginning with the longest fibers.
[5] Difference between fiber lengths at 90- and at 10-percent points on the length-cumulative-weight percentage curve divided by the length at the 50-percent point, multiplied by 100.
[6] Lint samples ginned with a loose seed roll, at manufacturer's recommended gin-saw speed, using 12 inches of pressure for doffing. The letter "B" following grade symbols indicates normal preparation for long-staple cotton and "sp." indicates spotted cotton. (For a complete key to grade symbols see U. S. Dept. of Agr. Misc. Pub. 310, The Classification of Cotton.)
[7] Equal portions from lot ginned on each of the 2 gins.

In addition to the identification, the moisture and foreign-matter contents of each cotton are given in table 1. Since moisture content of the seed cotton and staple length as appraised by the cotton classers were found to influence the ease with which the lint is removed from the saws by the stripping blast, groupings of the data by each of these factors are employed. These groupings are used throughout this circular in presenting the results and the relationship obtained. Laboratory determinations of upper-quartile fiber length and variability of fiber length, as well as the weight of 100 seeds, weight of lint from 100 seeds, and proportion of lint are given for each lot of seed cotton involved. Grade and staple-length designations are also indicated for samples ginned from each lot with the 12-inch pressure condition.

From each lot of cotton involved in these tests, one portion was ginned with a nozzle pressure or water gage of 9 inches, a second portion with 12, and a third with 15 inches.

During each test, appropriate samples were taken at the condenser to be classed and reviewed by Government classers and to be subjected to laboratory determinations of brilliance, fiber length, and variability of fiber length. The laboratory measurements of brilliance provided a further check on the grade relations. Length-distribution studies, made in the fiber-array laboratories, provided a basis for a more detailed comparison of the effects of methods of doffing on the fiber length and uniformity of fiber length.[6] Records of power requirements, ginning time, lint percentage, and other factors were made during each test. The data from these tests were then analyzed statistically and their significance was determined for use as a sound basis for interpretations of results.

TABLE 2.—*Average effect of specified air-blast nozzle pressure on classer's designation of grade and on laboratory determination of brilliance*

Moisture-content group (percent)	Nozzle pressure	Classer's designation of grade [1]	Laboratory determinations of brilliance [2]	Moisture-content group (percent)	Nozzle pressure	Classer's designation of grade [1]	Laboratory determinations of brilliance [2]
COTTON 1⅛ INCHES AND LONGER							
	Inches	*Code points*	*Units*		*Inches*	*Code points*	*Units*
12 and above	9	4.7	8.86	Below 12	9	5.1	8.74
	12	4.5	8.88		12	5.1	8.77
	15	4.6	8.86		15	5.1	8.74
COTTON SHORTER THAN 1⅛ INCHES							
12 and above	9	5.4	8.56	Below 12	9	5.0	8.78
	12	5.2	8.59		12	5.0	8.76
	15	5.2	8.58		15	5.0	8.77

[1] The indices used for grade designation are 4 for Strict Middling, 5 for Middling, and 6 for Strict Low Middling, the decimals denoting proportionate fractions of grade.

[2] Brilliance readings of cotton samples range from approximately 7 to 9 on a scale extending in equal steps from 0, which is black, to 10, which is white. The difference between Middling and Strict Middling grades is of the order of 0.10 in brilliance; differences between the lower grades are greater.

[6] For a detailed discussion of laboratory and statistical methods see the following: GEDDES, FRANCIS L., and BENNETT, CHARLES A. EFFECT OF ARTIFICIALLY DRYING SEED COTTON BEFORE GINNING ON CERTAIN QUALITY ELEMENTS OF THE LINT AND SEED AND ON THE OPERATION OF THE GIN STAND. U. S. Dept. Agr. Tech. Bull. 508, 62 pp., illus. 1936.

EFFECT ON QUALITY AND VALUE OF LINT

Variations made in air-blast pressure had little effect on the grade of the lint ginned from dry cottons, but with the damp and wet cottons the blast of the 9-inch pressure operation was not adequate to remove the lint from the saws. For cotton with a moisture content above 12 percent, lower grades were associated with the 9-inch than with the 12-inch water pressure (table 2). If the pressure is not high enough for efficient doffing, the undoffed lint is carried by the saws through the lower rib rail and back into the roll box. Frequently in this process, damp lint accumulates in the spaces between the lower section of the ginning ribs where it is damaged by the

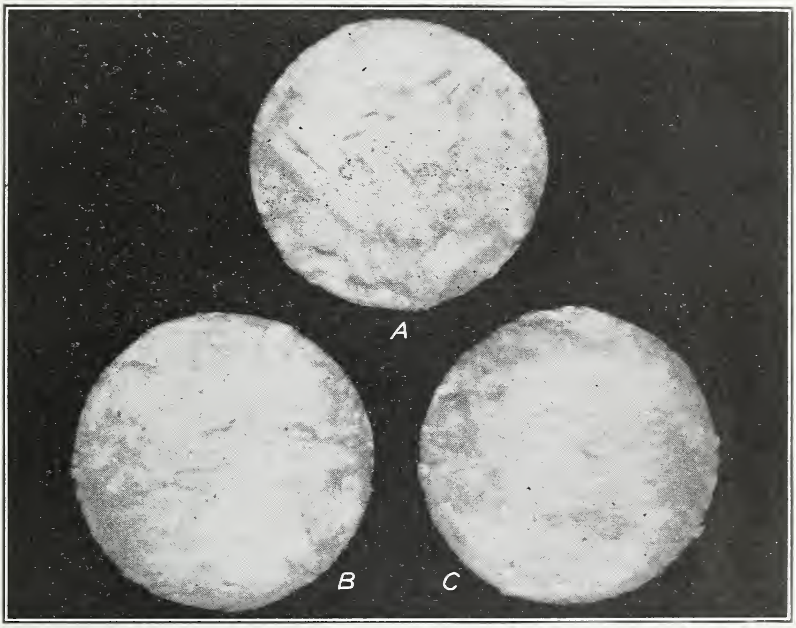

FIGURE 2.—Portions of lint ginned from the same lot of seed cotton: *A*, With 9-inch nozzle pressure; *B*, with 12-inch nozzle pressure; *C*, with 15-inch nozzle pressure.

saws. The dry cottons used in these tests were found to be less susceptible to damage at this point. Even with the damp or wet cottons tested, the blast of the 12-inch pressure operation was ample; and the increases made to 15 inches not only gave no further benefits from the standpoint of influencing the grade of the lint but in some instances resulted in a lowering of the grade. In general, the relationships shown by laboratory measurement of brilliance were similar to those indicated by grade-classification data.[7] Differences in grade unfavorable to the pressure of 9 inches were due almost entirely

[7] The correlation between grade and brilliance is high because brilliance measurements are affected by three grade factors; that is, by the greater or smaller number of shadows which accompany different degrees of preparation, by the color of the lint itself, and by the quantity of leaf.

to differences in preparation or smoothness of the lint. The tangling of the undoffed lint while being returned to the roll box and subjected to the repeated action of the saws is responsible for this effect on preparation. Samples from ginnings made with each of the three air-blast pressures tested are shown in figure 2.

The staple length designated by the classer, the upper-quartile fiber length, and the variability of fiber length determined in the laboratory, did not show any apparent differences when the nozzle pressure was decreased or increased 3 inches from the customary pressure of 12 inches (table 3). Fiber arrays were made only on the samples ginned on the high-speed gin which gave a sufficient number of samples for statistical analysis of the data.

TABLE 3.—*Average effect of specified air-blast nozzle pressure on laboratory determinations of upper-quartile fiber length and variability of fiber length and on classer's designation of staple length of ginned lint*

COTTON 1⅛ INCHES AND LONGER

Moisture-content group (percent)	Nozzle pressure	Laboratory determinations of [1]—		Classer's designation of staple length	Moisture-content group (percent)	Nozzle pressure	Laboratory determinations of [1]—		Classer's designation of staple length
		Upper-quartile fiber length [2]	Variability of fiber length [3]				Upper-quartile fiber length [2]	Variability of fiber length [3]	
	Inches	*Inches*	*Percent*	*1/32 inch*		*Inches*	*Inches*	*Percent*	*1/32 inch*
12 and above	9	1.22	90.5	37.4	Below 12	9	1.18	98.8	36.4
	12	1.23	89.1	37.5		12	1.17	103.9	36.4
	15	1.23	89.9	37.4		15	1.17	101.1	36.4

COTTON SHORTER THAN 1⅛ INCHES

Moisture-content group (percent)	Nozzle pressure	Upper-quartile fiber length	Variability of fiber length	Classer's designation of staple length	Moisture-content group (percent)	Nozzle pressure	Upper-quartile fiber length	Variability of fiber length	Classer's designation of staple length
12 and above	9	0.96	96.6	30.8	Below 12	9	1.03	106.7	32.2
	12	.97	98.1	30.8		12	1.02	109.3	32.2
	15	.96	95.1	30.8		15	1.01	110.7	32.2

[1] Laboratory determinations were made only on the 29 cottons ginned on the high-speed gin.
[2] Length of fibers at the 25-percent point on the length-cumulative-weight percentage curve beginning with the longest fibers.
[3] Difference between fiber lengths at 90- and 10-percent points on the length-cumulative-weight percentage curve divided by the length at 50-percent point.

Differences in grade resulting from changes in air-blast pressure are reflected in differences in the price per pound paid for the lint.[8] These differences in price per pound along with differences in the amount of lint obtained are responsible for significant variations in the value of the lint ginned by the various air-blast pressures. The effect of these different air-blast pressures on the quantity of lint obtained was more important, however, than the effect on the quality of the lint (table 4). In considering the effects of variations in air-blast pressure and other elements of ginning on the value of the lint, it should be pointed out that although differences in the price of cotton due to differences in quality may not always be reflected

[8] The prices indicated were calculated from data on file in the Bureau of Agricultural Economics, relating to the approximate average price per pound of cotton of specified white grades and staple lengths prevailing at Memphis, Tenn., for the seasons of 1932–33, 1933–34, 1934–35, and 1935–36.

back to the grower,[9] the commercial use of methods of ginning that improve the quality of cotton helps to raise the average price received by growers in a given market.

Losses in bale weight caused by inadequate air-blast pressure amounted to an average of 4 pounds with each of the groups of damp or wet cottons, and 3 pounds with each of the groups of dry cottons. The losses in bale weight are caused by the pressure being too low to doff all of the lint from the saws, thereby making them somewhat less efficient in removing the lint from the seed. Losses smaller than these generally accompanied the use of the high pressure of 15 inches, and probably they are attributable to back pressure caused by eddy currents in the region of the saws.

TABLE 4.—*Average effect of specified air-blast nozzle pressure on monetary value of the ginned lint*

COTTON 1⅛ INCHES AND LONGER

Moisture-content group (percent)	Nozzle pressure	Price per pound [1]	Bale weight [2]	Value per bale	Moisture-content group (percent)	Nozzle pressure	Price per pound [1]	Bale weight [2]	Value per bale
	Inches	*Cents*	*Pounds*	*Dollars*		*Inches*	*Cents*	*Pounds*	*Dollars*
12 and above	9	13.21	458	60.58	Below 12	9	11.99	471	56.58
	12	13.32	462	61.56		12	12.02	474	57.03
	15	13.23	460	60.95		15	12.01	473	56.81

COTTON SHORTER THAN 1⅛ INCHES

Moisture-content group (percent)	Nozzle pressure	Price per pound [1]	Bale weight [2]	Value per bale	Moisture-content group (percent)	Nozzle pressure	Price per pound [1]	Bale weight [2]	Value per bale
12 and above	9	10.67	482	51.38	Below 12	9	11.09	496	54.97
	12	10.75	486	52.18		12	11.10	499	55.30
	15	10.75	484	51.99		15	11.08	498	55.22

[1] Calculated from approximate average prices per pound of cotton of specified white grades and staple lengths prevailing at Memphis, Tenn., for the seasons 1932–33, 1933–34, 1934–35, and 1935–36.
[2] Calculated by applying the turn-out percentage of lint to 1,500 pounds of seed cotton and adding 22 pounds for bagging and ties.

The pressure of 12 inches was optimum from the standpoint of influencing bale value, especially with the damp or wet cotton. Compared with this pressure, the pressure of 9 inches produced bale-value losses on the moist cottons of almost $1 when the staple length was long and 80 cents when it was short. The higher pressure of 15 inches showed no advantage over the pressure of 12 inches with these cottons; in fact, it was unfavorable. Even with the dry cotton, losses of 45 and 33 cents, respectively, were found for long and short staples, with the use of 9 instead of 12 inches of pressure. The high pressure of 15 inches caused slight losses in most instances.

EFFECT ON GINNING TIME, POWER REQUIREMENTS, AND ENERGY CONSUMPTION OF THE GIN STAND

Slight but consistent increases in ginning time were caused by reducing the air-blast pressure from 12 to 9 inches (table 5). In other words, this low pressure was not effective enough in removing the lint from the saws to give optimum ginning capacity. With a

[9] HOWELL, L. D., and BURGESS, JOHN S., JR. FARM PRICES OF COTTON RELATED TO ITS GRADE AND STAPLE LENGTH IN THE UNITED STATES, SEASONS 1928–29 TO 1932–33. U. S. Dept. Agr. Tech. Bull. 493, 63 pp., illus. 1936.

pressure of 15 inches, the ginning capacity was similar to that obtained with 12.

Power requirements of the air-blast system increased with increased air-blast pressure, because the fan speed was increased to provide for it. Generally, the power requirement for gin operation with the pressure of 12 inches was greater by 2 horsepower, or about 14 percent than that required for the 9-inch pressure operation. By increasing the pressure from 12 to 15 inches, the increase in power requirements amounted to about 2½ horsepower, or was about 18 percent greater than that required for the 12-inch pressure.

TABLE 5.—*Average effect of specified air-blast nozzle pressure on ginning time, power requirements, and energy consumption of the gin stand*

COTTON 1⅛ INCHES AND LONGER

Moisture-content group (percent)	Nozzle pressure	Ginning time [1]	Power requirements [2]	Energy consumption [1 2]	Moisture-content group (percent)	Nozzle pressure	Ginning time [1]	Power requirements [2]	Energy consumption [1 2]
	Inches	*Minutes*	*Horsepower*	*Kilowatt-hours*		*Inches*	*Minutes*	*Horsepower*	*Kilowatt-hours*
12 and above	9	50	10.3	6.4	Below 12	9	54	12.1	8.0
	12	49	12.3	7.4		12	53	13.9	9.0
	15	50	14.9	9.2		15	52	16.2	10.4
COTTON SHORTER THAN 1⅛ INCHES									
12 and above	9	50	11.3	7.0	Below 12	9	53	11.7	7.6
	12	48	13.0	7.8		12	52	13.6	8.8
	15	48	15.1	8.9		15	52	16.2	10.4

[1] For ginning 1,500 pounds of seed cotton.
[2] For feeder, air-blast, and gin saws.

The difference in power requirements for the low- and the medium-pressure runs caused a difference in energy consumption of about 1 kilowatt-hour per bale, or about 12 percent for the gin stand. This increased energy consumption for the 12-inch-pressure ginning on electrically driven gins amounts to a maximum cost of about 4 cents per bale which is small compared with the increases in bale value previously discussed. Changing the pressure from 12 to 15 inches caused energy consumption to increase in proportion to the increase in power requirements, or about 18 percent.

DESIGN AND SETTING OF AIR-BLAST NOZZLES

The design and setting of air-blast nozzles has a distinctive function in providing smooth and efficient ginning. Therefore, it is important for gins of the air-blast type to be equipped with well-constructed nozzles, and it is desirable for their operators to be familiar with the operation and setting of the nozzle in relation to the saw.

Air-blast nozzles vary in size and shape, depending on the design and make of the gin stand. In a battery of gin stands, the air from the fan is conveyed through a main pipe that is mounted back of the several gins and connected with their nozzles. The air reservoir terminates near the gin cylinder with an elongated slotlike nozzle

for emitting the stripping blast against the peripheral portions of the saws in their general direction and approximately at a tangent. Nozzles have $\frac{3}{16}$- to $\frac{5}{16}$-inch openings and are from $\frac{1}{2}$ to 1 inch longer than the saw cylinders. These elongated nozzles are held in a fixed position by a setscrew on each side of the gin.

When these screws are loosened, the nozzle can be moved toward or away from the saws by pivoting it on a point on the gin frame upon which the entire reservoir and nozzle assembly rests. The nozzle orifice must be parallel to the axis of the saw cylinder. The usual operating setting of the nozzle of an air-blast gin is one-sixteenth to

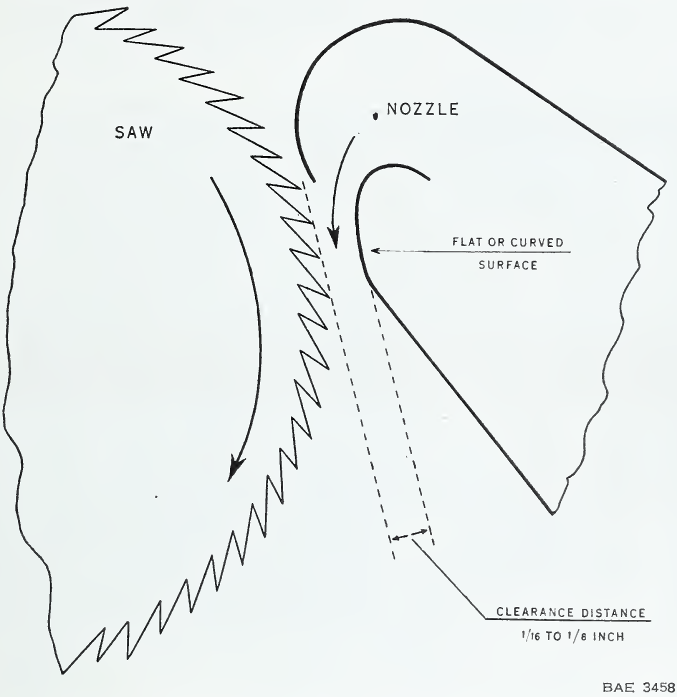

FIGURE 3.—Setting of nozzle with respect to gin saw.

one-eighth of an inch from the saw. Correct setting of the nozzle is indicated in figure 3.

At the Cotton Ginning Laboratories, tests have been made to determine the effects on lint quality and ginning efficiency of nozzle settings of one-sixteenth, one-eighth, and three-sixteenths of an inch. These tests indicate that the gin manufacturers' recommended nozzle setting of one-sixteenth to one-eighth of an inch is generally desirable.

MAINTAINING AIR-BLAST PRESSURES

Air-blast gins usually require a volume of air ranging from 155 to 175 cubic feet per minute per 10 saws, depending on the pressure needed for efficient doffing of the lint from the saws. In practice, new installations of air-blast systems are so designed that normal

pressures are provided under average operating and maintenance conditions.

Few commercial gins are equipped with variable-speed units or other convenient means for reducing fan speeds to provide the lower air-blast pressures that can frequently be used when dry cotton is being ginned, or the higher pressures that may be required for doffing when damp or heavy cotton is being ginned. But a valve on the intake side of the fan, similar to the one shown in figure 4, offers an economical and practical means of changing the volume of air for the stripping blast without changing the speed of the fan. A slide damper of the type shown in figure 5, will achieve substantially the same results as this cone type if it is placed at a distance of at least four pipe diameters from the inlet.

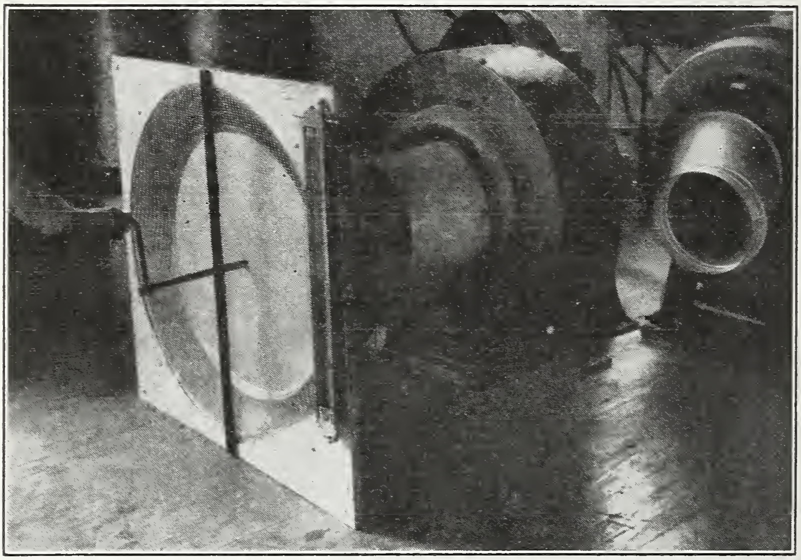

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FIGURE 4.—Government-design cone type of air-blast fan-intake control.

To hold power costs of air-blast systems to a minimum, it is highly advisable to have an efficient piping lay-out. The piping should be of the proper size, and all joints should be taped or otherwise sealed and made as airtight as possible. A loss of air around the joints will necessarily increase the volume needed to insure a given pressure at the nozzle. The efficient piping lay-out for an air-blast system should be as free as possible from obstructions, abrupt bends, and unnecessary curves (fig. 6).

Air-blast systems should have a fan of a size to insure economical performance under normal conditions. Undersized fans operated at excessive speeds generally require more power than fans of optimum size operated at moderate speeds. When necessary, repairs should be made to fan scrolls and wheels in order to maintain proper volumes of air without increasing the speed.

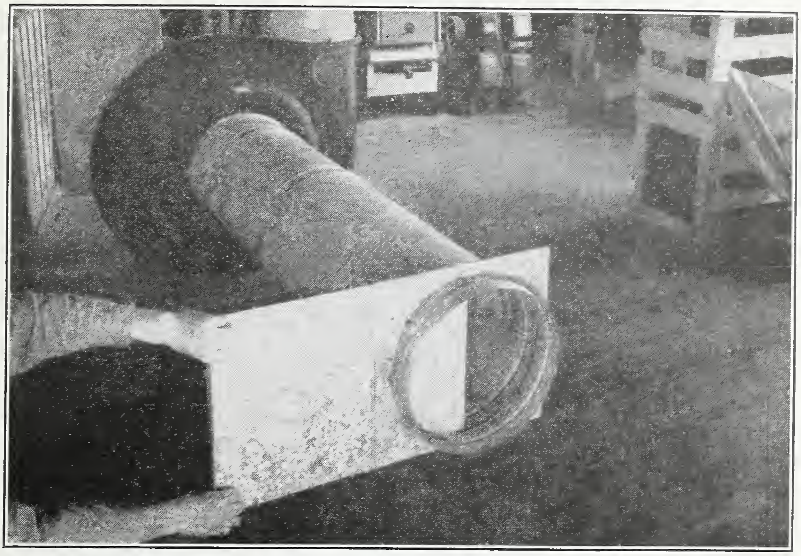

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FIGURE 5.—Slide damper of air-blast fan-intake control.

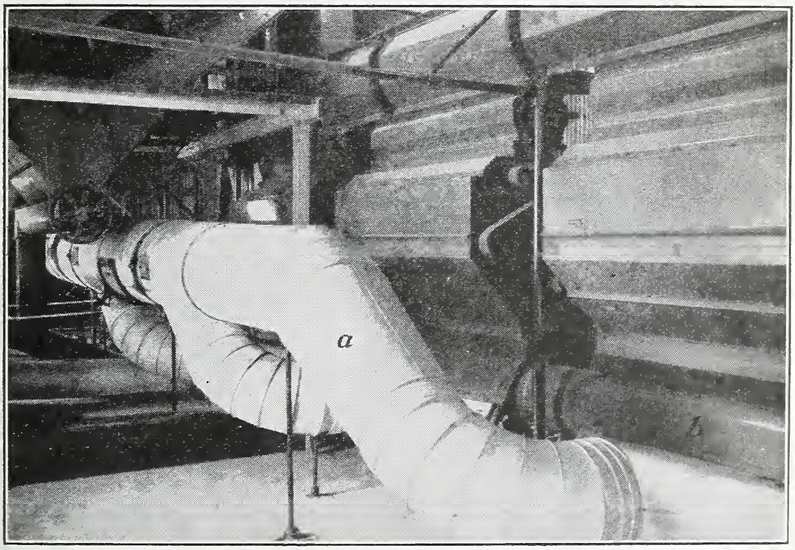

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FIGURE 6.—Piping lay-out for an air-blast system: *a*, Lint flue; *b*, air reservoir for nozzle.

INSTRUMENTS FOR CHECKING AIR-BLAST NOZZLE PRESSURES AND SETTINGS

For measuring the air-blast pressure of individual gin stands, a very useful instrument is the portable air-blast nozzle-pressure gage illustrated in figure 7. The first step in using this gage is to see that it is plumb and that the surface of the liquid in both tubes is at zero. Next, the tip of the copper tubing is held so that it almost touches the nozzle of the air-blast gin (fig. 8). The blast of air from the nozzle must flow into this tube in a straight line, and readings should be taken at both ends of each gin stand in an effort to determine

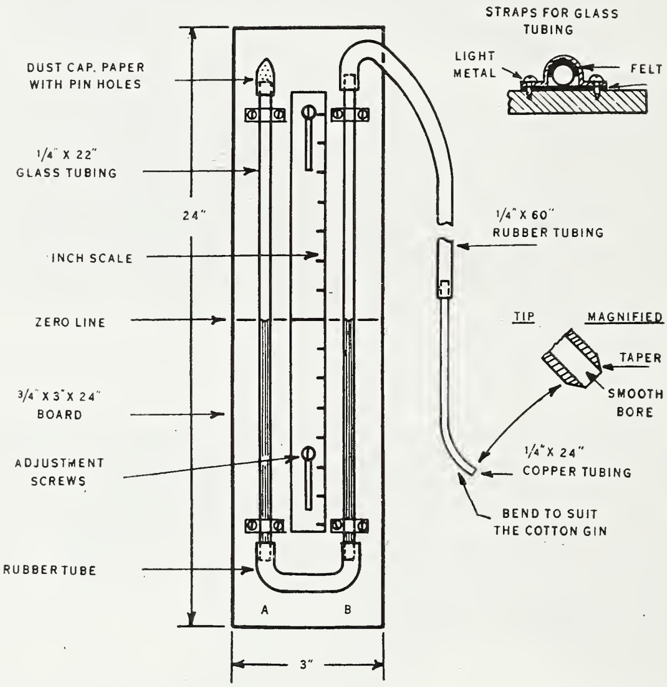

FIGURE 7.—Details of an air-blast nozzle-pressure gage.

whether uniform pressure is maintained throughout the nozzle. The readings of all gins in a battery should be the same.

Another method of checking pressures of air-blast gins is to use the stationary air-blast gage, by measuring the static pressure in the piping from the fan to the gin (fig. 9). This installation should be placed at some accessible point on the gin-floor operating region, as close to the gin stands as possible. To compensate for pipe friction, an additional inch of pressure is required on the static tube gage for each 16-pipe-diameter distance between the gage and the nearest gin stand. It is essential that the copper static tube be placed at the center of the air pipe with the tip toward the fan and against the direction of the air flow in the pipe.

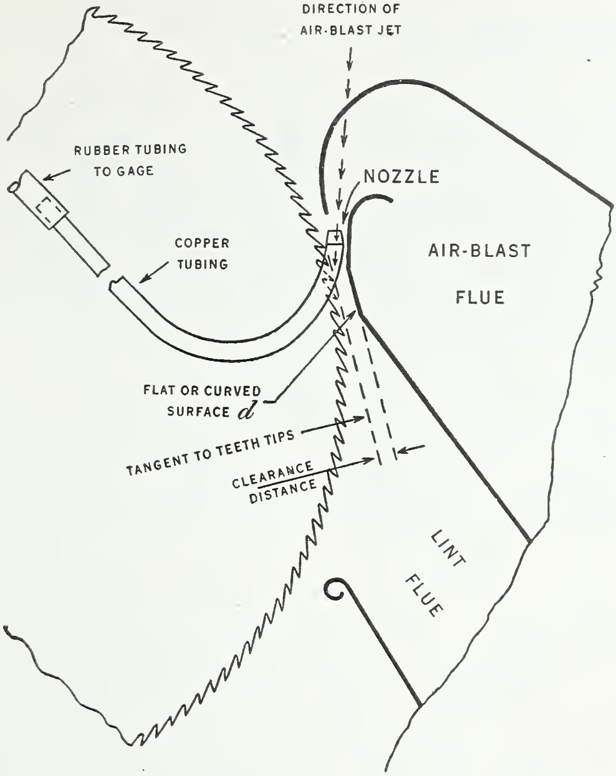

FIGURE 8.—Application of air-blast nozzle-pressure gage, showing positions of tip of copper tube.

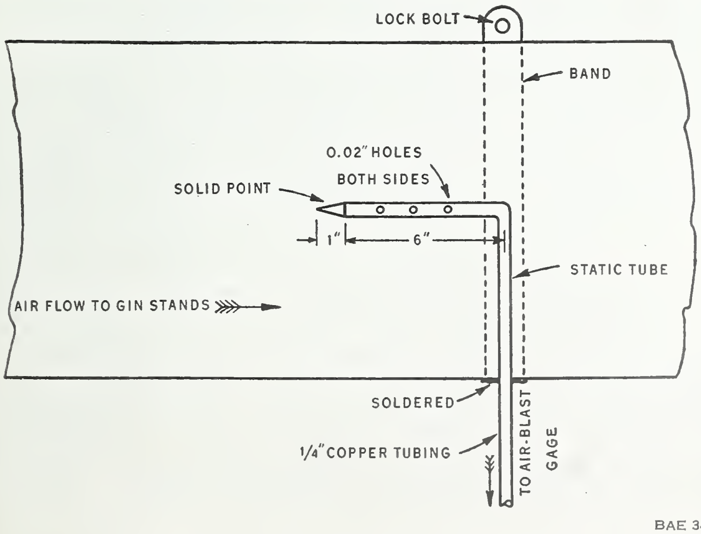

FIGURE 9.—Details of static-tube installation.

The static-pressure reading, made with the stationary gage, will not be identical with the reading of the portable gage but should correspond within a fraction of an inch of water pressure.

The nozzle setting and the nozzle width, or opening, can be checked by use of the two gages shown in figure 10. With these instruments the nozzle clearance should be measured at point *d*, shown in figure 8, and the nozzle width at the opening where the air leaves the nozzle. Another simple instrument for testing nozzle settings, recommended by some gin manufacturers, consists of a bale tie about 2 feet long bent to fit the curvature of the saw cylinder. This instrument should be passed between the gin saws and the face of the nozzle. It should pass freely from one end of the nozzle to the other, but should almost touch the gin saws.

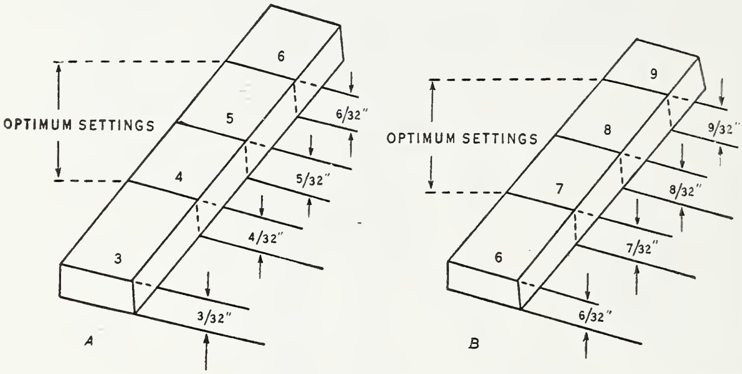

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FIGURE 10.—Air-blast nozzle gages: *A*, Nozzle-setting gage; *B*, nozzle-width gage.

SUMMARY

Ginning of cotton on air-blast gins with insufficient nozzle pressure is a source of inefficiency in ginning and of damage to lint quality, especially with damp cottons. A comparison of results obtained with air-blast ginning by nozzle pressures of 9, 12, and 15 inches in an extensive series of tests (on cottons ranging widely in moisture content, staple length, and other conditions and qualities) shows that the quality of the lint as ascertained by classifications and laboratory measurements was slightly damaged when the nozzle pressure was reduced from 12 to 9 inches, in ginning the damp or wet cotton.

The lower pressure (9 inches) was less efficient in doffing and caused losses in gin turn-out of 4 pounds per bale on the damper cotton, as compared with the pressure of 12 inches. As a result of these losses in bale weight, the differences in lint quality, and the average price relationships existing during the 4 years 1932–33 to 1935–36, the bale-value losses amounted to about $1 per bale on the long-staple and about 80 cents on the short-staple cotton ginned in a moist condition. For the drier cottons, the bale-value losses for the 9-inch pressure operation were smaller because of lower losses in bale weight and lack of noticeable damage to quality. These losses

amounted to 45 cents and 33 cents with the long- and short-staple cotton, respectively. By increasing the nozzle pressure from 12 to 15 inches, a decline in bale value was noted for both damp and dry cotton.

Proper attention by the ginner to nozzle pressures for maximum efficiency should result in increased profits, through savings in energy consumed. Increasing the nozzle pressure from 9 to 12 inches by increasing the fan speed increased energy consumption 12 percent. It may be possible in some gins, by improvements and adequate repairs, to slow down the fans and actually save power, and at the same time provide sufficient pressure for efficient air-blast doffing.

Correct air-blast pressure in a commercial gin can best be maintained by controlling the volume of air by means of an intake valve on the fan. Gin nozzles should be given periodic attention to be sure that they are not battered, bent, nor clogged. They should be open so as to allow the free passage of air at a tangent to the gin saws. The air-blast fan, one of the greatest users of power in the entire ginning set-up, deserves especial attention.

Air-blast nozzle-pressure gage and air-blast nozzle-setting and width gages, are useful in operating air-blast gins economically.

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